MISSOURI DEPARTMENT OF HEALTH

John Ashcroft
Governor

John R. Bagby, Ph.D.
Director

P.O. Box 570, Jefferson City, MO 65102 • 314-751-6400 • FAX 314-751-6010

73024

North End Site
MOD985768194
2.4

May 19, 1991

5-19-91

RECEIVED

MAY 22 1992

SPFD BRANCH

Mr. Robert L. Morby
Chief, Superfund Branch
Waste Management Division
U. S. Environmental Protection Agency
726 Minnesota Avenue
Kansas City, Kansas 66101

Dear Mr. Morby:

Under the Cooperative Agreement between the U. S. Environmental Protection Agency (EPA) and the Missouri Department of Health (MDOH), EPA has directed that MDOH prepare a residual risk assessment for groundwater contamination found at the North End Site, Kansas City, Missouri. Enclosed please find the draft residual Risk Assessment for the North End Site.

MDOH appreciates the opportunity to provide you with this document. If you have any questions or comments regarding this assessment, please feel free to contact Ms. Cherri Baysinger-Daniel or Mr. Chuck Arnold at (314) 751-6102.

Sincerely,

Daryl W. Roberts
Chief
Bureau of Environmental Epidemiology

DWR:CCA

Enclosure

cc: David Crawford, U. S. Environmental Protection Agency

S00073480
SUPERFUND RECORDS

DRAFT RESIDUAL RISK ASSESSMENT FOR GROUNDWATER CONTAMINATION NORTH END SITE

1.0 INTRODUCTION

1.1 Objective

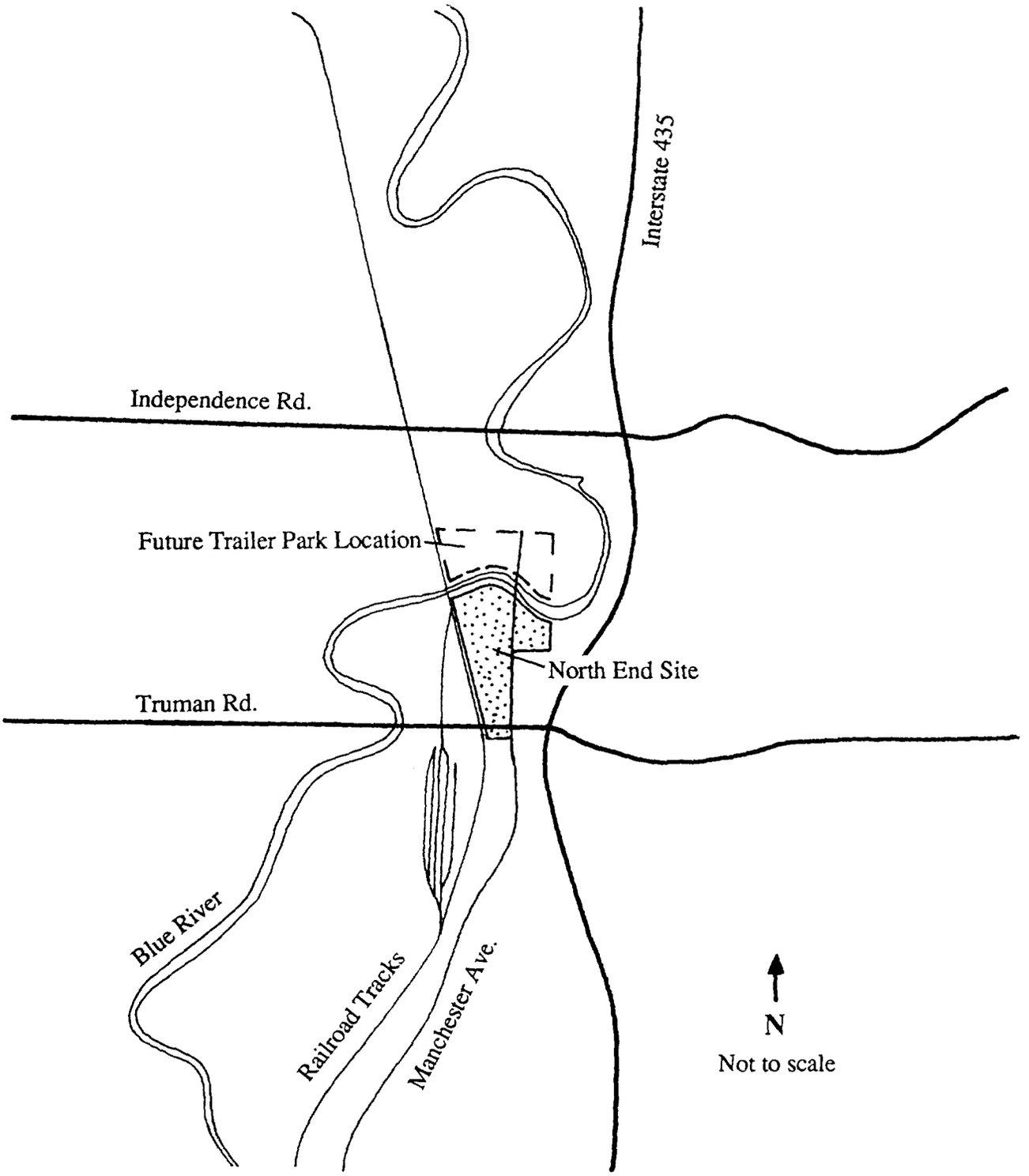
The North End Site was used for the disposal for lead-contaminated wastes resulting from the production of steel. Remedial activities at the site included soil removal and installation of groundwater monitoring wells. The Missouri Department of Health (DOH) was tasked by the U. S. Environmental Protection Agency (EPA) to conduct a risk assessment to determine if remaining groundwater contamination warrants cleanup.

1.2 Site Background

The North End Site is located in an industrialized area of Kansas City, Missouri, within the Armco complex, an active steel manufacturing facility (Figure 1). From 1962 to 1980, the North End Site was used as a landfill for the disposal of lead-contaminated electric furnace baghouse dusts generated during steel production.

In complying with the Administrative Order of Consent (AOC) , Armco Inc. conducted a removal of lead-contaminated soil at the North End Site. This included excavation, sorting and staging, testing, off-site disposal , and verification of the effectiveness of the removal action. Over 26,000 cubic yards of material were excavated and disposed of in permitted landfills. Lead concentrations in soil samples taken following completion of soil removal were less than the clean-up criterion of 238 mg/kg total lead. After confirmatory sampling and analysis was completed, the site was backfilled, graded, and seeded.

Pursuant to the AOC, Armco installed two deep and three shallow monitoring wells (in addition to ten existing wells) for further collection and analysis of groundwater. Sampling of all site wells was conducted in March and again in May, 1991. Lead and several volatile organic compounds (VOCs) were detected.



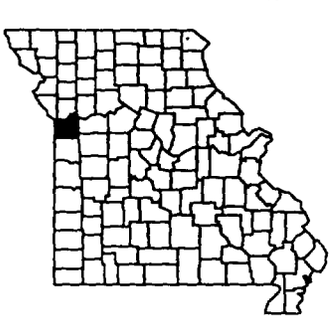


Figure 1.
General Site Diagram and Location of Hypothetical Future Trailer Park North End Superfund Site Kansas City, MO.

1.3 Scope of Risk Assessment

This risk assessment will evaluate the human health risks posed to a hypothetical future offsite resident drinking and showering with groundwater contaminated by lead and the volatile organic compounds detected at the North End Site.

2.0 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

2.1 Site Geology

The North End Site is underlain by Quaternary Alluvium of the Blue River. Soil consistency ranges from moist to saturated interbedded clayey silt and silty clay with small amounts of fine sand in the upper soils to poorly sorted silty gravels and sand in the lower soils sitting above bedrock. A zone of reduced permeability consisting of stiff, silty clay lies between the two soil types. Groundwater investigation results indicate the unconsolidated aquifer is comprised of an upper and lower zone each having slightly different hydraulic conductivities. Sampling results (absence of VOCs in deep wells) suggest the alluvium acts as two separate aquifers, both discharging to the Blue River.

2.2 Data Collection

Prior to the removal action, ten shallow monitoring wells (screened between 16 to 25 feet below ground surface (bgs)) were located on the North End Site. Under the AOC, Armco installed five additional wells; two deep wells (screened between 58 to 64 feet bgs) and three shallow wells (screened between 8 to 13 feet bgs). Because of deep excavation for waste removal prior to the May sampling, one well was abandoned and sealed. A replacement well was installed in close proximity. Fifteen wells were sampled during March and May of 1991, and the results used in this risk assessment.

2.3 Data Evaluation

All groundwater samples were analyzed for total phenolics, nitrates, total and dissolved lead, priority pollutant VOCs, polychlorinated biphenyls, pH, specific conductance and alkalinity. Total lead was present in detectable levels in all groundwater samples in concentrations up to 400 ug/L (Appendix I). Dissolved lead was not detected in any groundwater samples. The following VOCs were detected at least once in at least one well during groundwater sampling: chlorethane, chloromethane, 1,2 dichlorobenzene, 1,1 dichloroethane, 1,2 dichloroethane, 1,1 dichloroethene, 1,2 dichloroethene, tetrachloroethene, 1,1,1 trichloroethane, trichloroethene, and vinyl chloride (Appendix I).

Contaminants of concern were limited to total lead and the volatile organic compounds detected at least once during groundwater sampling (Table 1). Average contaminant concentrations for each well were calculated from the March and May sampling data. For contaminants of concern undetected during one sampling round, one-half the detection limit was used to calculate average contaminant concentrations. Contaminant concentrations for VOCs in wells from which a replicate sample had been taken are the arithmetic average of the initial and replicate sample results. Contaminant concentrations from all wells were combined to calculate the site mean, maximum , minimum , standard deviation, and 95% Upper Confidence Level (UCL) values (Table 1).

2.4 Uncertainties

During the second round of sampling, vinyl chloride was detected in only one sample; the compound identification was certain but the concentration was an estimated value (J-qualified, Appendix I). Chloromethane, 1,2 dichlorobenzene, and 1,2 dichloroethene were detected during the first round of sampling but not detected during the second round of sampling (Appendix 1). Because these compounds were included in the risk assessment, the true risk posed by the site may be overestimated.

3.0 EXPOSURE ASSESSMENT

3.1 Current Exposure Pathways

Land use in the vicinity of the North End Site is currently industrial. Contaminated soil was removed, precluding current or future exposure to contaminated soil. No drinking water wells are currently located on site, thus on-site exposure through ingestion of contaminated groundwater is not expected. Therefore, no current exposure pathways were evaluated.

3.2 Future Exposure Pathways

The industrialized nature of the area is not expected to change, but the possibility exists for a residential community to be established across the Blue River north of the site (see Figure 1). For the purposes of this risk assessment, EPA has directed DOH to assume future land use on adjacent property would be residential; i.e., land across the Blue River from the North End Site would be used as a trailer park and drinking water would be supplied by a community well. Exposure pathways for future residential land use were

Table 1.

Summary Statistics for Contaminants of Concern in Groundwater at the North End Superfund Site, Kansas City, MO.

Contaminant	Mean Concentration (mg/L)	Maximum Value (mg/L)	Minimum Value (mg/L)	Standard Deviation	95% Upper Confidence Limit
Total Lead	0.063	0.229	0.0095	0.055	0.0918
Chloroethane	0.017	0.170	0.005	0.041	0.0390
Chloromethane	0.007	0.025	0.005	0.005	0.00972
1,2 Dichlorobenzene	0.004	0.013	0.0025	0.003	0.00521
1,1 Dichloroethane	0.065	0.610	0.0025	0.159	0.149
1,2 Dichloroethane	0.003	0.013	0.0025	0.003	0.00481
1,1 Dichloroethene	0.039	0.340	0.0025	0.086	0.0840
1,2 Dichloroethene	0.004	0.018	0.00225	0.004	0.00580
Tetrachloroethene	0.005	0.029	0.0025	0.007	0.00855
1,1,1 Trichloroethane	0.028	0.220	0.0025	0.057	0.0578
Trichloroethene	0.004	0.013	0.0025	0.003	0.00569
Vinyl Chloride	0.008	0.035	0.005	0.008	0.0119

ingestion of contaminated drinking water and inhalation of volatilized VOCs during showering.

The Blue River is generally considered to be a hydrologic barrier to groundwater movement. For the purposes of this risk assessment and to ensure protectiveness of human health, it is assumed that the community well would be large enough to pull water across the hydrologic divide formed by the Blue River. EPA estimates that the well would obtain 1% of its water supply from the North End Site, thus contaminant concentrations in the community well would be 1/100th of the average concentrations beneath the North End site (Table 2).

3.3 Reasonable Maximim Exposures (RMEs)

For the future land use scenario, two RMEs were developed by EPA using site specific assumptions. RME 1 was a 15-kilogram child, 0-6 years of age, living in the trailer park for 6 years, ingesting and showering with contaminated groundwater. RME 2 was a 70-kilogram adult living in the trailer park for thirty years ingesting contaminated groundwater and inhaling volatilized VOCs while showering.

3.4 Calculation of Air Concentrations

Contaminant concentrations in air (mg/m^3) while showering (Table 3) were calculated from groundwater concentrations (mg/L) using the following formula:

$$\text{Concentration in Air} = \frac{(\text{Concentration in Water})(\text{Liters/shower})(\text{VolatilizationFactor})}{(\text{Room Volume})}$$

This formula was modified from ECAO (1991). In these calculations, the values 180 liters and 10 m^3, respectively, were used as site-specific estimates of the number of liters per shower and the room volume. A value of 0.5 (0.0005 x 1000 L/m^3) was used as the volatilization factor (EPA 1991c).

3.5 Estimation of Chemical Intakes

Intake rates for all contaminants were quantified using the pathway-specific equations (Tables 4 and 5) taken from EPA (1989) Risk Assessment Guidance for Superfund: Volume I (RAGS). Exposure variables used in the equations were chosen by EPA personnel so that the combination of all intake variables resulted in a RME for each contaminant within a pathway (Appendix II).

Table 2.

Calculated Concentrations of Contaminants of Concern in a Hypothetical Future Drinking Water Well, North End Superfund Site, Kansas City, MO.

Contaminant	95% Upper Confidence Limit (mg/L)	Assumed Percentage of Contaminated Water Entering the Community Well	Calculated Concentration in Community Well Water (mg/L)
Total Lead	9.18×10^{-2}	1×10^{-2}	9.18×10^{-4}
Chloroethane	3.90×10^{-2}	1×10^{-2}	3.90×10^{-4}
Chloromethane	9.72×10^{-3}	1×10^{-2}	9.72×10^{-5}
1,2 Dichlorobenzene	5.21×10^{-3}	1×10^{-2}	5.21×10^{-5}
1,1 Dichloroethane	1.49×10^{-1}	1×10^{-2}	1.49×10^{-3}
1,2 Dichloroethane	4.81×10^{-3}	1×10^{-2}	4.81×10^{-5}
1,1 Dichloroethene	8.40×10^{-2}	1×10^{-2}	8.40×10^{-4}
1,2 Dichloroethene	5.80×10^{-3}	1×10^{-2}	5.80×10^{-5}
Tetrachloroethene	8.55×10^{-3}	1×10^{-2}	8.55×10^{-5}
1,1,1 Trichloroethane	5.78×10^{-2}	1×10^{-2}	5.78×10^{-4}
Trichloroethene	5.69×10^{-3}	1×10^{-2}	5.69×10^{-5}
Vinyl Chloride	1.19×10^{-2}	1×10^{-2}	1.19×10^{-4}

Table 3.

Calculated Concentrations of Volatile Compounds in Air While Showering North End Superfund Site, Kansas City, MO.

Contaminant	Size of Bathroom (m3)	Liters of Water Used Per Shower (L)	Contaminant Concentration in Groundwater (mg/L)	Volatility	Contaminant Concentration in Air (mg/m^3)
Chloroethane	10	180	0.00039	0.5	0.00351
Chloromethane	10	180	0.0000972	0.5	0.0008748
1,2 Dichlorobenzene	10	180	0.0000521	0.5	0.0004689
1,1 Dichloroethane	10	180	0.00149	0.5	0.01341
1,2 Dichloroethane	10	180	0.0000481	0.5	0.0004329
1,1 Dichloroethene	10	180	0.00084	0.5	0.00756
1,2 Dichloroethene	10	180	0.000058	0.5	0.000522
Tetrachloroethene	10	180	0.0000855	0.5	0.0007695
1,1,1 Trichloroethane	10	180	0.000578	0.5	0.005202
Trichloroethene	10	180	0.0000569	0.5	0.0005121
Vinyl Chloride	10	180	0.000116	0.5	0.001044

Table 4.

Intake Equations for Ingestion of Contaminated Groundwater North End Superfund Site, Kansas City, MO.*

Equation:

Chronic Daily Intake (mg/kg/day)=CW x IR x EF x ED / (BW x AT)

Where:

CW=Chemical Concentration in Groundwater (mg/L)
IR=Ingestion Rate (L water/day)
EF=Exposure Frequency (days/year)
ED=Exposure Duration (years)
BW=Body Weight (kg)
AT=Averaging Time (days)

Variable values:

CS=site specific calculated value (Table 2)
IR=1 L/day - child
2 L/day - adult (EPA 1990)
EF=365 days/year (number of days in a year)
ED=6 years - child
30 years - adult
BW=15 kg (arithmetic mean of 50th percentile body weights of children aged 0-6 years)
70 kg - adult (EPA 1990)
AT=2190 days for child - noncarcinogenic effects (ED x 365 days/year)
10950 days for adult - noncarcinogenic effects (ED x 365 days/year)
25550 days for child and adult carcinogenic effects (70 years x 365 days/year)

*Formula was obtained from EPA 1989

Table 5.

Inhalation of Volatized Compounds While Showering North End Superfund Site, Kansas City, MO.*

Equation:

Chronic Daily Intake (mg/kg/day)=CA x IR x ET x EF x ED / (BW x AT)

Where:

CA=Chemical Concentration in air (mg/m^3)
IR=Inhalation Rate (m^3/hr)
ET=Exposure Time (hours/day)
EF=Exposure Frequency (days/year)
ED=Exposure Duration (years)
BW=Body Weight (kg)
AT=Averaging Time (days)

Variable values:

CA=calculated chemical concentration (Table 3)
IR=0.83 m^3/hour (EPA 1990)
ET=0.25 hour/day (site specific estimate)
EF=365 days/year (assumes one shower per day)
ED=6 years - child
30 years - adult
BW=15 kg (arithmetic mean of 50^{th} percentile body weights of children aged 0-6 years)
70 kg - adult (EPA 1990)
AT=2190 days for child - noncarcinogenic effects (ED x 365 days/year)
10950 days for adult - noncarcinogenic effects (ED x 365 days/year)
25550 days for child and adult carcinogenic effects (70 years x 365 days/year)

*Formula was obtained from EPA 1989

The Lead Biokinetic Uptake Model was used to estimate intake of lead from groundwater. The model was run using a groundwater concentration of 0.918 ug/L with default values for soil, air, food and paint.

4.0 TOXICITY ASSESSMENT

4.1 Noncarcinogenic Effects

Reference Doses (RfDs)and Reference Concentrations (RfCs) are the toxicity values used in assessing noncarcinogenic effects from oral and inhalation exposure, respectively. EPA's Integrated Risk Information System (IRIS) contains contaminant specific RfD and RfC values which have been verified by an intra-Agency work group. RfD and RfC values which have not been verified may be found in EPA Health Effects Assessment Summary Tables (HEAST, EPA 1991b). Available toxicity values and effects of concern associated with exposure to specific contaminants are summarized in Table 6.

Unit Risks were converted to RfCs using the formula taken from the preface to HEAST, 1991 Annual Volume (EPA 1991). The formula is as follows:

$$RfC = (\text{Unit Risk})\ (\text{Inhalation Rate})\ (\text{Body Weight})$$

where Inhalation Rate = 0.83 m^3/hour and Body Weight = 15 kg. (child) or 70 kg. (adult).

Currently, there are no toxicity values for lead in IRIS or HEAST (EPA 1991b). Lead intake affects virtually every system in the body. Among the most serious effects of lead exposure are the central nervous system effects seen in young children. These effects range from impaired learning ability and a decrease in IQ scores to brain damage. Other effects are a decrease in growth of children, a decrease in hearing acuity and adverse effects on the kidneys and hematopoetic systems (CDC 1991). To assess the adverse health effects of lead exposure, EPA currently advises use of the Lead Biokinetic Uptake Model. This model combines intake variables from several potential lead exposure pathways and predicts blood lead levels for children. Predicted blood lead levels greater than 10 ug/dL are considered to present a health hazard.

Table 6.

Noncarcinogenic Toxicity Information for Chemicals of Concern at the North End Superfund Site, Kansas City, MO.*

Compound	Oral Reference Dose (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Effects of Concern (oral; inhalation)
Chronic Exposures			
Chloroethane	ND	1×10^{-1}	NA; developmental toxicity
1,2 Dichlorobenzene	9×10^{-2}	4×10^{-2}	Liver effects; decreased body weight gain
1,1 Dichloroethane	1×10^{-1}	1×10^{-1}	NA; kidney damage
1,1 Dichloroethene	9×10^{-3}	ND	Liver lesions; NA
1,2 Dichloroethene	1×10^{-2}	ND	Decreased hematocrit and hemoglobin; NA
Tetrachloroethene	1×10^{-2}	ND	Hepatotoxicity; NA
1,1,1 Trichloroethane	9×10^{-2}	3×10^{-1}	Hepatotoxicity, hepatotoxicity
Trichloroethene**	6 x 10-3	ND	Kidney and liver effects; NA
Subchronic Exposures			
Chloroethane	ND	1×10^{1}	NA; developmental toxicity
1,2 Dichlorobenzene	9×10^{-1}	4×10^{-1}	Liver effects; decreased body weight gain
1,1 Dichloroethane	1×10^{0}	1×10^{0}	NA; kidney damage
1,1 Dichloroethene	9×10^{-3}	ND	Liver lesions; NA
1,2 Dichloroethene	1×10^{-1}	ND	Decreased hematocrit and hemoglobin; NA
Tetrachloroethene	1×10^{-1}	ND	Hepatotoxicity; NA
1,1,1 Trichloroethane	9×10^{-1}	3×10^{0}	Hepatotoxicity, hepatotoxicity
Trichloroethene**	6 x 10-3	ND	Kidney and liver effects; NA

* All toxicity values were taken from the 1991 Annual Volume of the Health Effects Assessment Summary Tables, except for the Chronic Reference Dose for Tetrachloroethene. That value was taken from the Integrated Risk Information System Database.
**Toxicity Information provided by the Environmental Criteria and Assessment Office (Appendix III).

4.2 Carcinogenic Effects

Slope factors found in IRIS and HEAST are used to assess carcinogenic effects for specific contaminants. A Slope factor is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical expressed over a lifetime. Slope factors for the specific contaminants, weight of evidence classifications for carcinogenicity, and site of tumor data are summarized in Table 7.

5.0 RISK CHARACTERIZATION

5.1 Noncarcinogenic Risk

Noncancer hazard quotients are calculated for each contaminant in each pathway by dividing the Chronic Daily Intake (CDI) by the RfD. The noncancer hazard quotients within an exposure pathway are summed to give the pathway hazard index. The Total Hazard Index is then calculated by summing the pathway hazard indices. According to RAGS (EPA 1989), human health risks may exist when the Total Hazard Index exceeds unity (1.0).

5.1.1 RME 1

The pathway hazard indices for ingestion of contaminated drinking water and inhalation of volatilized VOCS during showering were 3.1×10^{-4} and 2.4×10^{-5}, respectively. Chemicals which drove the risk assessment were 1,1 dichloroethene for ingestion of contaminated drinking water and 1,1 dichloroethane for inhalation of volatilized VOCs. Total Hazard Index calculated for RME 1 was 3.3×10^{-4} (Table 8). Because this is less than 1.0, potential health risks are not indicated for a child living across the Blue River from the North End Site, ingesting 1 liter of contaminated drinking water per day and inhaling volatilized VOCs 0.25 hours per day, 365 days per year for 6 years.

The Lead Biokinetic Uptake Model was used to predict blood lead levels of a child living in the trailer park across from the North End Site. Groundwater concentrations of 0.918 ug/L were used in the intake calculations. Blood lead levels between 2.77 and 3.21 ug/dL were predicted by the model. Because these values are well below 10 ug/dL, predicted lead concentrations in groundwater are not expected to cause adverse health effects to a child living across the Blue River from the North End Site.

Table 7.

Carcinogenic Toxicity Values for Chemicals of Concern Found at the North End Superfund Site, Kansas City, MO.*

Contaminant	Oral Slope Factor $(mg/kg/day)^{-1}$	Inhalation Slope Factor $(mg/kg/day)^{-1}$	Weight of Evidence Classification and Tumor Site (oral; inhalation)
Chloromethane	1.3×10^{-2}	6.0×10^{-3}	C - Kidney; kidney
1,1 Dichloroethane	ND	ND	C - NA; hemangiosarcoma
1,2 Dichloroethane	9.1×10^{-2}	9.1×10^{-2}	B2 - Circulatory; circulatory
1,1 Dichloroethene	6.0×10^{-1}	1.2×10^{0}	C - Kidney; adrenal
Trichloroethene	1.1×10^{-2}	1.7×10^{-2}	B2 - Lung; liver
Vinyl chloride	1.9×10^{0}	2.9×10^{-1}	A - Liver; lung

* All slope factors except for cholormethane and trichloroethene were obtained from the Integrated Risk Information System database. Slope Factors for cholormethane and trichloroethene were obtained from the 1991 Annual Volume of the Health Effects Assessment Summary Tables.

Table 8.

Hazard Index Values for RME 1
North End Superfund Site, Kansas City, MO

Pathway: Ingestion of contaminated drinking water by a 15 kg child over a 6 year period.					
Chemical	**Concentration (mg/L)**	**Chronic Daily Intake (mg/kg/day)**	**RfD (mg/kg/day)**	**Hazard Index**	**Pathway Hazard Index**
1,2 Dichlorobenzene	0.0000521	3.2×10^{-6}	9×10^{-1}	3.6×10^{-6}	
1,1 Dichloroethane	0.00149	9.2×10^{-5}	1×10^{0}	9.2×10^{-5}	
1,1 Dichloroethene	0.00084	1.7×10^{-6}	9×10^{-3}	1.9×10^{-4}	
1,2 Dichloroethene	0.000058	1.2×10^{-7}	1×10^{-1}	1.2×10^{-6}	
Tetrachloroethene	0.0000855	1.7×10^{-7}	1×10^{-1}	1.7×10^{-6}	
1,1,1 Trichloroethane	0.000578	1.2×10^{-6}	9×10^{-1}	1.3×10^{-6}	
Trichloroethene	0.0000569	1.2×10^{-7}	6×10^{-3}	1.9×10^{-5}	**3.1×10^{-4}**
Pathway: Inhalation of volatized compounds during showering by a 15 kg child over a 6 year period.					
Chemical	**Concentration (mg/m^3)**	**Chronic Daily Intake (mg/kg/day)**	**RfC (mg/kg/day)**	**Hazard Index**	**Pathway Hazard Index**
Chloroethane	0.00039	5.0×10^{-6}	1×10^{1}	5.0×10^{-7}	
1,2 Dichlorobenzene	0.0000521	6.6×10^{-7}	4×10^{-1}	1.7×10^{-6}	
1,1 Dichloroethane	0.00149	1.9×10^{-5}	1×10^{0}	1.9×10^{-5}	
1,1,1 Trichloroethane	0.000578	7.4×10^{-6}	3×10^{0}	2.5×10^{-6}	**2.4×10^{-5}**
		Total Hazard Index			**3.3×10^{-4}**

5.1.2 RME 2

The pathway hazard indices for ingestion of contaminated drinking water and inhalation of volatilized VOCS during showering were 4.0×10^{-3} and 5.4×10^{-5}, respectively. Chemicals which drove the risk assessment were 1,1 dichloroethene for ingestion of contaminated drinking water and 1,1 dichloroethane for inhalation of volatilized VOCs. Total Hazard Index calculated for RME 2 was 4.0×10^{-3} (Table 9). Because this is less than 1.0, potential health risks are not indicated for an adult living across the Blue River from the North End Site, ingesting 2 liters of contaminated drinking water per day and inhaling volatilized VOCs 0.25 hours per day, 365 days per year for 30 years.

The Lead Biokinetic Uptake Model was used to predict blood lead levels of an adult living in the trailer park across from the North End Site. Groundwater concentrations of 0.918 ug/L were used in the intake calculations. Blood lead levels between 2.77 and 3.21 ug/dL were predicted by the model. Because these values are well below10 ug/dL, predicted lead concentrations in groundwater are not expected to cause adverse health effects to an adult living across the Blue River from the North End Site.

5.2 Carcinogenic Risk

Lifetime excess cancer risks are calculated for each contaminant in each pathway by multiplying the slope factor by the Chronic Daily Intake (CDI). Within a pathway, the chemical specific risks are summed to give the total pathway risk. The Total Lifetime Excess Cancer Risk is then determined by summing the total pathway risks. According to RAGS (EPA 1989), a cancer risk may exist when the Total Lifetime Excess Cancer Risk exceeds the 1×10^{-4} to 1×10^{-6} range.

5.2.1 RME 1

Pathway cancer risks for ingestion of contaminated drinking water and inhalation of volatilized VOCs during showering were 4.2×10^{-6} and 1.2×10^{-6}, respectively. The chemical which drove the risk assessment was 1,1 dichloroethene for ingestion of contaminated drinking water and inhalation of volatilized VOCs. Total Excess Lifetime Cancer Risk calculated for RME 1 was 5.4×10^{-6} (Table 10). Although the lower end of the range of acceptable cancer risk has been exceeded, the predicted excess lifetime cancer risk is still well below the upper end of the acceptable range for a child living across the Blue River from the North End Site, ingesting 1 liter of contaminated drinking water per day and inhaling volatilized VOCs 0.25 hours per day, 365 days per year for 6 years.

Table 9.

Hazard Index Values for RME 2
North End Superfund Site, Kansas City, MO.

Pathway: Ingestion of contaminated drinking water by a 70 kg adult over a 30 year period.					
Chemical	**Concentration (mg/L)**	**Chronic Daily Intake (mg/kg/day)**	**RfD (mg/kg/day)**	**Hazard Index**	**Pathway Hazard Index**
1,2 Dichlorobenzene	0.0000521	1.5×10^{-6}	9×10^{-2}	1.7×10^{-5}	
1,1 Dichloroethane	0.00149	4.2×10^{-5}	1×10^{-1}	4.2×10^{-4}	
1,1 Dichloroethene	0.00084	2.4×10^{-5}	9×10^{-3}	2.7×10^{-3}	
1,2 Dichloroethene	0.000058	1.6×10^{-6}	1×10^{-2}	1.6×10^{-4}	
Tetrachloroethene	0.0000855	2.4×10^{-6}	1×10^{-2}	2.4×10^{-4}	
1,1,1 Trichloroethane	0.000578	1.6×10^{-5}	9×10^{-2}	1.8×10^{-4}	
Trichloroethene	0.0000569	1.6×10^{-6}	6×10^{-3}	2.7×10^{-4}	**4.0×10^{-3}**
Pathway: Inhalation of volatized compounds while showering by a 70 kg adult over a 30 year period.					
Chemical	**Concentration (mg/m^3)**	**Chronic Daily Intake (mg/kg/day)**	**RfC (mg/kg/day)**	**Hazard Index**	**Pathway Hazard Index**
Chloroethane	0.00039	1.2×10^{-6}	1×10^{1}	1.2×10^{-7}	
1,2 Dichlorobenzene	0.0000521	1.5×10^{-7}	4×10^{-2}	3.8×10^{-6}	
1,1 Dichloroethane	0.00149	4.4×10^{-6}	1×10^{-1}	4.4×10^{-5}	
1,1,1 Trichloroethane	0.000578	1.7×10^{-6}	3×10^{-1}	5.7×10^{-6}	**5.4×10^{-5}**
		Total Hazard Index			**4.0×10^{-3}**

Table 10.

Excess Lifetime Cancer Risks for RME 1
North End Superfund Site, Kansas City, MO.

Pathway: Ingestion of contaminated drinking water by a 15 kg child over a 6 year period.					
Chemical	**Concentration (mg/L)**	**Chronic Daily Intake (mg/kg/day)**	**Slope Factor (mg/kg/day)-1**	**Cancer Risk**	**Pathway Cancer Risk**
Chloromethane	0.0000972	5.5×10^{-7}	1.3×10^{-2}	7.2×10^{-9}	
1,2 Dichloroethane	0.0000481	2.7×10^{-7}	9.1×10^{-2}	2.5×10^{-8}	
1,1 Dichloroethene	0.00084	4.8×10^{-6}	6.0×10^{-1}	2.9×10^{-6}	
Trichloroethene	0.0000569	3.2×10^{-7}	1.1×10^{-2}	3.6×10^{-9}	
Vinyl Chloride	0.000116	6.7×10^{-7}	1.9×10^{0}	1.2×10^{-6}	**4.2×10^{-6}**
Pathway: Inhalation volatized compounds during showering by a 15 kg child over a 6 year period.					
Chemical	**Concentration (mg/m^3)**	**Chronic Daily Intake (mg/kg/day)**	**Slope Factor (mg/kg/day)-1**	**Cancer Risk**	**Pathway Cancer Risk**
Chloromethane	0.0000972	1.2×10^{-7}	6.3×10^{-3}	7.6×10^{-10}	
1,2 Dichloroethane	0.0000481	5.7×10^{-8}	9.1×10^{-2}	5.1×10^{-9}	
1,1 Dichloroethene	0.00084	1.0×10^{-6}	1.2×10^{0}	1.2×10^{-6}	
Trichloroethene	0.0000569	6.7×10^{-8}	1.7×10^{-2}	1.0×10^{-9}	
Vinyl Chloride	0.000116	1.4×10^{-7}	2.9×10^{-1}	4.0×10^{-8}	**1.2×10^{-6}**
		Excess Lifetime Cancer Risk			**5.4×10^{-6}**

5.2.2 RME 2

Pathway cancer risks for ingestion of contaminated drinking water and inhalation of volatilized VOCs during showering were 9.0×10^{-6} and 3.2×10^{-5}, respectively. The chemical which drove the risk assessment was 1,1 dichloroethene for ingestion of contaminated drinking water and inhalation of volatilized VOCs. Total Excess Lifetime Cancer Risk calculated for RME 2 was 4.1×10^{-5} (Table 11). Although the lower end of the range of acceptable cancer risks has been exceeded, the predicted excess lifetime cancer risk is still well below the upper end of the acceptable range for an adult living across the Blue River from the North End Site, ingesting 2 liters of contaminated drinking water per day and inhaling volatilized VOCs 0.25 hours per day, 365 days per year for 30 years.

5.3 Uncertainties

Several areas of uncertainty are inherent in the risk assessment process. Most intake variables used are 95% upper confidence limits of the mean variable value. This may overestimate the true risk posed by the site. Many RfDs, RfCs and SFs are based on toxicity tests carried out on animals. It is not known if results of these tests are applicable to humans.

The Lead Biokinetic Uptake Model used to predict blood lead levels was developed for children aged 0-6 years, the ages at which effects from lead exposure are most dramatic. Effects of lead exposure are less prominent in older children and adults, thus the risk for adults from ingesting lead at the North End Site is probably lower than estimated in this assessment.

Four contaminants of concern undetected during the second round of sampling were retained in this risk assessment based upon an assumption that mixing will occur during movement of groundwater. This assumption may over- or underestimate the true risk posed by the site.

6.0 SUMMARY

The North End Site was used as a landfill for the burial of lead-contaminated wastes. A soil removal action was completed and groundwater monitoring wells installed. Total lead and some VOCs were detected in groundwater under the site. EPA directed DOH to assess the risks posed to a hypothetical future offsite resident ingesting contaminated drinking water and inhaling volatilized VOCs while showering.

Table 11.

Excess Lifetime Cancer Risks for RME 2
North End Superfund Site, Kansas City, MO.

Pathway: Ingestion of contaminated drinking water by a 70 kg adult over a 30 year period.					
Chemical	**Concentration (mg/L)**	**Chronic Daily Intake (mg/kg/day)**	**Slope Factor (mg/kg/day)-1**	**Cancer Risk**	**Pathway Cancer Risk**
Chloromethane	0.0000972	1.1×10^{-6}	1.3×10^{-2}	1.5×10^{-8}	
1,2 Dichloroethane	0.0000481	5.9×10^{-7}	9.1×10^{-2}	5.4×10^{-8}	
1,1 Dichloroethene	0.00084	1.0×10^{-5}	6.0×10^{-1}	6.2×10^{-6}	
Trichloroethene	0.0000569	7.0×10^{-7}	1.1×10^{-2}	7.7×10^{-9}	
Vinyl Chloride	0.000116	1.4×10^{-6}	1.9×10^{0}	2.7×10^{-6}	**9.0×10^{-6}**
Pathway: Inhalation of volatized compounds by a 70 kg adult while showering over a 30 year period.					
Chemical	**Concentration (mg/m^3)**	**Chronic Daily Intake (mg/kg/day)**	**Slope Factor (mg/kg/day)-1**	**Cancer Risk**	**Pathway Cancer Risk**
Chloromethane	0.0000972	3.0×10^{-6}	6.3×10^{-3}	1.8×10^{-8}	
1,2 Dichloroethane	0.0000481	1.5×10^{-6}	9.1×10^{-2}	1.4×10^{-7}	
1,1 Dichloroethene	0.00084	2.6×10^{-5}	1.2×10^{0}	3.1×10^{-5}	
Trichloroethene	0.0000569	1.7×10^{-6}	1.7×10^{-2}	2.8×10^{-8}	
Vinyl Chloride	0.000116	3.6×10^{-6}	2.9×10^{-1}	1.0×10^{-6}	**3.2×10^{-5}**
		Excess Lifetime Cancer Risk			**4.1×10^{-5}**

Two RMEs were considered for future land use: a child (RME 1) and an adult (RME 2) ingesting contaminated drinking water and inhaling volatilized VOCs while showering. There were no noncarcinogenic risks posed to a child or adult ingesting contaminated groundwater or inhaling volatilized VOCs while showering. Pathway cancer risks ranged from 1.2×10^{-6} to 3.2×10^{-5}. While these estimates exceed the lower end of the acceptable cancer risk range (1×10^{-6}), they are still below the upper end of the acceptable range (1×10^{-4}).

The Lead Biokinetic Uptake model predicted Blood Lead Levels ranging from 2.77 to 3.21 ug/dL. Because these levels do not exceed 10 ug/dL., a health hazard is not considered to exist from ingestion of contaminated drinking water across the Blue River from the North End Site.

LITERATURE CITED

Centers for Disease Control (CDC). 1991. Preventing Lead Poisoning in Children. U. S. Department of Health and Human Services, Atlanta, GA.

Environmental Criteria and Assessment Office (ECAO). 1991. Inhalation Exposure to Volatile Organic Compounds from Showering with Contaminated Groundwater (Park Mobile Home Court Site/Norfolk, NE).

Environmental Protection Agency (EPA). 1989. Risk assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002.

Environmental Protection Agency (EPA). 1990. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/8-89/043.

Environmental Protection Agency (EPA). 1991a. Human Health Evaluation Manual, Supplemental Guaidance: (Standard Default Exposure Factors.) OSWER Directive 9285.6-03.

Environmental Protection Agency (EPA). 1991b. Health Effects Assessment Summary Tables, Annual FY-1991. Office of Emergency and Remedial Response. OERR 9200.6-303 (91-1).

Environmental Protection Agency (EPA). 1991c. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals). Office of Emergency and Remedial Response. OERR 9285.7-01B. December, 1991.

APPENDIX I
Summary of Groundwater Sampling Results from the North End Site

TABLE 4

RESULTS OF GROUND WATER ANALYSES
MARCH 13, 1991

PARAMETER	UNITS	RAU-MW -001-15	RAU-MW -001D-15	RAU-MW -002-15	RAU-MW -003-15	RAU-MW -003D-15
WATER LEVEL	ft-msl	733.85	736.66	733.16	733.86	736.60
GENERAL CHEMISTRY						
pH	s.u.	6.4	7.1	6.1	6.5	7.0
SPECIFIC CONDUCTANCE	µmho/cm	1500	740	3100	850	540
ACIDITY AS CaCO3	mg/l	<1.0	16	1.5	<1.0	<1.0
ALKALINITY AS CaCO3	mg/l	470	430	240	300	280
NITRATES AS NO3-N	mg/l	0.29	0.11	0.24	0.30	0.13
PHENOLICS	mg/l	<0.005	<0.005	0.009	0.008	0.006
TOTAL LEAD	mg/l	0.058	0.024	0.049	0.063	0.010
DISSOLVED LEAD	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003
POLYCHLORINATED BIPHENYL	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0
VOLATILE ORGANIC COMPOUNDS						
ACROLEIN	µg/l	<50	<50	<50	<125	<50
ACRYLONITRILE	µg/l	<50	<50	<50	<125	<50
BENZENE	µg/l	<5	<5	<5	<12	<5
BROMODICHLOROMETHANE	µg/l	<5	<5	<5	<12	<5
BROMOFORM	µg/l	<5	<5	<5	<12	<5
BROMOMETHANE	µg/l	<10	<10	<10	<25	<10
CARBON TETRACHLORIDE	µg/l	<5	<5	<5	<12	<5
CHLOROBENZENE	µg/l	<5	<5	<5	<12	<5
CHLOROETHANE	µg/l	160	<10	<10	<25	<10
2-CHLOROETHYLVINYL ETHER	µg/l	<10	<10	<10	<25	<10
CHLOROFORM	µg/l	<5	<5	<5	<12	<5
CHLOROMETHANE	µg/l	<10	<10	<10	<25	<10
DIBROMOCHLOROMETHANE	µg/l	<5	<5	<5	<12	<5
1,2-DICHLOROBENZENE	µg/l	<5	<5	<5	<12	<5
1,3-DICHLOROBENZENE	µg/l	<5	<5	<5	<12	<5
1,4-DICHLOROBENZENE	µg/l	<5	<5	<5	<12	<5
1,1-DICHLOROETHANE	µg/l	200	<5	8	35	<5
1,2-DICHLOROETHANE	µg/l	<5	<5	<5	<12	<5
1,1-DICHLOROETHENE	µg/l	29	<5	<5	270	<5
1,2-DICHLOROETHENE	µg/l	12	<5	<5	6	<5
1,2-DICHLOROPROPANE	µg/l	<5	<5	<5	<12	<5
cis-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<12	<5
trans-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<12	<5
ETHYLBENZENE	µg/l	<5	<5	<5	<12	<5
METHYLENE CHLORIDE	µg/l	<10	<10	<10	<25	<10
1,1,2,2-TETRACHLOROETHANE	µg/l	<5	<5	<5	<12	<5
TETRACHLOROETHENE	µg/l	<5	<5	<5	6	<5
TOLUENE	µg/l	<5	<5	<5	<12	<5
1,1,1-TRICHLOROETHANE	µg/l	38	<5	<5	67	<5
1,1,2-TRICHLOROETHANE	µg/l	<5	<5	<5	<12	<5
TRICHLOROETHENE	µg/l	<5	<5	<5	<12	<5
TRICHLOROFLOUROMETHANE	µg/l	<5	<5	<5	<12	<5
VINYL CHLORIDE	µg/l	23	<10	<10	16	<10
TOTAL VOCs	µg/l	452	0	8	400	0

TABLE 4
(CONTINUED)

PARAMETER	UNITS	RAU-MW -003A-15	RAU-MW -004-15	RAU-MW -005-15	RAU-MW -006-15	RAU-MW 006R-15
WATER LEVEL	ft-msl	734.69	739.36	743.69	743.91	REPLICATE
GENERAL CHEMISTRY						
pH	s.u.	6.2	6.6	6.0	6.3	6.4
SPECIFIC CONDUCTANCE	µmho/cm	600	2900	1600	960	950
ACIDITY AS CaCO3	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0
ALKALINITY AS CaCO3	mg/l	140	450	110	140	140
NITRATES AS NO3-N	mg/l	0.16	1.00	0.18	0.19	0.21
PHENOLICS	mg/l	0.007	0.006	0.006	<0.005	<0.005
TOTAL LEAD	mg/l	0.011	0.058	0.026	0.015	0.028
DISSOLVED LEAD	mg/l	<0.003	0.020	<0.003	<0.003	<0.003
POLYCHLORINATED BIPHENYL	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0
VOLATILE ORGANIC COMPOUNDS						
ACROLEIN	µg/l	<50	<50	<50	<50	<50
ACRYLONITRILE	µg/l	<50	<50	<50	<50	<50
BENZENE	µg/l	<5	<5	<5	<5	<5
BROMODICHLOROMETHANE	µg/l	<5	<5	<5	<5	<5
BROMOFORM	µg/l	<5	<5	<5	<5	<5
BROMOMETHANE	µg/l	<10	<10	<10	<10	<10
CARBON TETRACHLORIDE	µg/l	<5	<5	<5	<5	<5
CHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
CHLOROETHANE	µg/l	<10	<10	<10	<10	<10
2-CHLOROETHYLVINYL ETHER	µg/l	<10	<10	<10	<10	<10
CHLOROFORM	µg/l	<5	<5	<5	<5	<5
CHLOROMETHANE	µg/l	20	<10	<10	<10	<10
DIBROMOCHLOROMETHANE	µg/l	<5	<5	<5	<5	<5
1,2-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,3-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,4-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,1-DICHLOROETHANE	µg/l	9	6	<5	<5	<5
1,2-DICHLOROETHANE	µg/l	<5	<5	<5	<5	<5
1,1-DICHLOROETHENE	µg/l	120	29	<5	<5	<5
1,2-DICHLOROETHENE	µg/l	<5	<5	<5	<5	<5
1,2-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
cis-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
trans-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
ETHYLBENZENE	µg/l	<5	<5	<5	<5	<5
METHYLENE CHLORIDE	µg/l	<10	<10	<10	<10	<10
1,1,2,2-TETRACHLOROETHANE	µg/l	<5	<5	<5	<5	<5
TETRACHLOROETHENE	µg/l	28	<5	<5	<5	<5
TOLUENE	µg/l	<5	<5	<5	<5	<5
1,1,1-TRICHLOROETHANE	µg/l	37	17	<5	<5	<5
1,1,2-TRICHLOROETHANE	µg/l	<5	<5	<5	<5	<5
TRICHLOROETHENE	µg/l	3	<5	<5	<5	<5
TRICHLOROFLOUROMETHANE	µg/l	<5	<5	<5	<5	<5
VINYL CHLORIDE	µg/l	<10	<10	<10	<10	<10
TOTAL VOCs	µg/l	217	52	0	0	0

TABLE 4
(CONTINUED)

PARAMETER	UNITS	RAU-MW -007-15	RAU-MW -008-15	RAU-MW -009-15	RAU-MW -010-15	RAU-MW -011-15
WATER LEVEL	ft-msl	746.43	738.31	743.91	732.83	733.08
GENERAL CHEMISTRY						
pH	s.u.	6.3	6.9	6.2	5.9	6.6
SPECIFIC CONDUCTANCE	µmho/cm	910	940	510	2900	960
ACIDITY AS CaCO3	mg/l	<1.0	<1.0	<1.0	8	<1.0
ALKALINITY AS CaCO3	mg/l	83	460	68	170	200
NITRATES AS NO3-N	mg/l	1.30	0.17	<0.10	0.44	0.26
PHENOLICS	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
TOTAL LEAD	mg/l	0.009	0.083	0.015	0.066	0.030
DISSOLVED LEAD	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003
POLYCHLORINATED BIPHENYL	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0
VOLATILE ORGANIC COMPOUNDS						
ACROLEIN	µg/l	<50	<50	<50	<250	<50
ACRYLONITRILE	µg/l	<50	<50	<50	<250	<50
BENZENE	µg/l	<5	<5	<5	<25	<5
BROMODICHLOROMETHANE	µg/l	<5	<5	<5	<25	<5
BROMOFORM	µg/l	<5	<5	<5	<25	<5
BROMOMETHANE	µg/l	<10	<10	<10	<50	<10
CARBON TETRACHLORIDE	µg/l	<5	<5	<5	<25	<5
CHLOROBENZENE	µg/l	<5	<5	<5	<25	<5
CHLOROETHANE	µg/l	<10	<10	<10	37	<10
2-CHLOROETHYLVINYL ETHER	µg/l	<10	<10	<10	<50	<10
CHLOROFORM	µg/l	<5	<5	<5	<25	<5
CHLOROMETHANE	µg/l	<10	<10	<10	<50	<10
DIBROMOCHLOROMETHANE	µg/l	<5	<5	<5	<25	<5
1,2-DICHLOROBENZENE	µg/l	<5	<5	15	<25	<5
1,3-DICHLOROBENZENE	µg/l	<5	<5	<5	<25	<5
1,4-DICHLOROBENZENE	µg/l	<5	<5	<5	<25	<5
1,1-DICHLOROETHANE	µg/l	<5	<5	<5	580	8
1,2-DICHLOROETHANE	µg/l	<5	<5	<5	<25	<5
1,1-DICHLOROETHENE	µg/l	<5	<5	<5	83	<5
1,2-DICHLOROETHENE	µg/l	<5	<5	3	23	<5
1,2-DICHLOROPROPANE	µg/l	<5	<5	<5	<25	<5
cis-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<25	<5
trans-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<25	<5
ETHYLBENZENE	µg/l	<5	<5	<5	<25	<5
METHYLENE CHLORIDE	µg/l	<10	<10	<10	<50	<10
1,1,2,2-TETRACHLOROETHANE	µg/l	<5	<5	<5	<25	<5
TETRACHLOROETHENE	µg/l	<5	<5	<5	<25	<5
TOLUENE	µg/l	<5	<5	<5	<25	<5
1,1,1-TRICHLOROETHANE	µg/l	<5	<5	<5	210	<5
1,1,2-TRICHLOROETHANE	µg/l	<5	<5	<5	<25	<5
TRICHLOROETHENE	µg/l	<5	<5	13	<25	<5
TRICHLOROFLOUROMETHANE	µg/l	<5	<5	<5	<25	<5
VINYL CHLORIDE	µg/l	<10	<10	<10	34	<10
TOTAL VOCs	µg/l	0	0	31	967	8

TABLE 4
(CONTINUED)

PARAMETER	UNITS	RAU-MW -012-15	RAU-MW -012R-15	RAU-MW -000-15	TRIP BLANK
WATER LEVEL	ft-msl	733.47	REPLICATE	BLANK	
GENERAL CHEMISTRY					
pH	s.u.	6.6		6.6	
SPECIFIC CONDUCTANCE	µmho/cm	1600		100	
ACIDITY AS CaCO3	mg/l	<1.0		11.	
ALKALINITY AS CaCO3	mg/l	680		7.8	
NITRATES AS NO3-N	mg/l	0.43		0.16	
PHENOLICS	mg/l	<0.005		<0.005	
TOTAL LEAD	mg/l	0.100		<0.003	
DISSOLVED LEAD	mg/l	<0.003		<0.003	
POLYCHLORINATED BIPHENYL	µg/l	<1.0		<1.0	
VOLATILE ORGANIC COMPOUNDS					
ACROLEIN	µg/l	<50	<50		<50
ACRYLONITRILE	µg/l	<50	<50		<50
BENZENE	µg/l	<5	<5		<5
BROMODICHLOROMETHANE	µg/l	<5	<5		<5
BROMOFORM	µg/l	<5	<5		<5
BROMOMETHANE	µg/l	<10	<10		<10
CARBON TETRACHLORIDE	µg/l	<5	<5		<5
CHLOROBENZENE	µg/l	<5	<5		<5
CHLOROETHANE	µg/l	<10	<10		<10
2-CHLOROETHYLVINYL ETHER	µg/l	<10	<10		<10
CHLOROFORM	µg/l	<5	<5		<5
CHLOROMETHANE	µg/l	<10	<10		<10
DIBROMOCHLOROMETHANE	µg/l	<5	<5		<5
1,2-DICHLOROBENZENE	µg/l	<5	<5		<5
1,3-DICHLOROBENZENE	µg/l	<5	<5		<5
1,4-DICHLOROBENZENE	µg/l	<5	<5		<5
1,1-DICHLOROETHANE	µg/l	120	120		<5
1,2-DICHLOROETHANE	µg/l	<5	<5		<5
1,1-DICHLOROETHENE	µg/l	<5	<5		<5
1,2-DICHLOROETHENE	µg/l	9	9		<5
1,2-DICHLOROPROPANE	µg/l	<5	<5		<5
cis-1,3-DICHLOROPROPANE	µg/l	<5	<5		<5
trans-1,3-DICHLOROPROPANE	µg/l	<5	<5		<5
ETHYLBENZENE	µg/l	<5	<5		<5
METHYLENE CHLORIDE	µg/l	<10	<10		<10
1,1,2,2-TETRACHLOROETHANE	µg/l	<5	<5		<5
TETRACHLOROETHENE	µg/l	<5	<5		<5
TOLUENE	µg/l	<5	<5		<5
1,1,1-TRICHLOROETHANE	µg/l	<5	<5		<5
1,1,2-TRICHLOROETHANE	µg/l	<5	<5		<5
TRICHLOROETHENE	µg/l	<5	<5		<5
TRICHLOROFLOUROMETHANE	µg/l	<5	<5		<5
VINYL CHLORIDE	µg/l	8	10		<10
TOTAL VOCs	µg/l	137	139		0

TABLE 5

RESULTS OF GROUND WATER ANALYSES
MAY 3,1991

PARAMETER	UNITS	RAU-MW -001-16	RAU-MW -001D-16	RAU-MW -002A-16	RAU-MW -003-16	RAU-MW -003D-16
WATER LEVEL	ft-msl	734.68	737.61		734.92	737.21
GENERAL CHEMISTRY						
pH	s.u.	6.4	6.8	6.0	6.6	6.9
SPECIFIC CONDUCTANCE	µmho/cm	1500	700	2900	780	580
ALKALINITY AS CaCO3	mg/l	460	410	290	330	330
NITRATES AS NO3-N	mg/l	0.32	0.20	0.40	0.40	0.14
PHENOLICS	mg/l	<0.006	<0.006	<0.006	<0.006	<0.006
TOTAL LEAD	mg/l	0.130	0.029	0.120	0.130	0.130
DISSOLVED LEAD	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003
POLYCHLORINATED BIPHENYLS	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0
VOLATILE ORGANIC COMPOUNDS						
ACROLEIN	µg/l	<50	<50	<50	<50	<50
ACRYLONITRILE	µg/l	<50	<50	<50	<50	<50
BENZENE	µg/l	<5	<5	<5	<5	<5
BROMODICHLOROMETHANE	µg/l	<5	<5	<5	<5	<5
BROMOFORM	µg/l	<5	<5	<5	<5	<5
BROMOMETHANE	µg/l	<10	<10	<10	<10	<10
CARBON TETRACHLORIDE	µg/l	<5	<5	<5	<5	<5
CHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
CHLOROETHANE	µg/l	180	<10	<10	<10	<10
2-CHLOROETHYLVINYL ETHER	µg/l	<10	<10	<10	<10	<10
CHLOROFORM	µg/l	<5	<5	<5	<5	<5
CHLOROMETHANE	µg/l	<10	<10	<10	<10	<10
DIBROMOCHLOROMETHANE	µg/l	<5	<5	<5	<5	<5
1,2-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,3-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,4-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,1-DICHLOROETHANE	µg/l	317	<5	<5	44	<5
1,2-DICHLOROETHANE	µg/l	<5	<5	<5	<5	<5
1,1-DICHLOROETHENE	µg/l	86	<5	4.8(J)	410	<5
1,2-DICHLOROETHENE	µg/l	<5	<5	<5	<5	<5
1,2-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
cis-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
trans-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
ETHYLBENZENE	µg/l	<5	<5	<5	<5	<5
METHYLENE CHLORIDE	µg/l	<10	<10	<10	<10	<10
1,1,2,2-TETRACHLOROETHANE	µg/l	<5	<5	<5	<5	<5
TETRACHLOROETHENE	µg/l	<5	<5	<5	<5	<5
TOLUENE	µg/l	<5	<5	<5	<5	<5
1,1,1-TRICHLOROETHANE	µg/l	85	<5	<5	98	<5
1,1,2-TRICHLOROETHANE	µg/l	<5	<5	<5	<5	<5
TRICHLOROETHENE	µg/l	<5	<5	<5	<5	<5
TRICHLOROFLOUROMETHANE	µg/l	<5	<5	<5	<5	<5
VINYL CHLORIDE	µg/l	<10	<10	<10	<10	<10
TOTAL VOCs	µg/l	668	0	5	552	0

TABLE 5
(CONTINUED)

PARAMETER	UNITS	RAU-MW -003A-16	RAU-MW -004-16	RAU-MW -005-16	RAU-MW -006-16	RAU-MW 006R-16
WATER LEVEL	ft-msl	736.38	738.91	743.64	744.65	REPLICATE
GENERAL CHEMISTRY						
pH	s.u.	6.1	6.3	5.9	6.2	6.1
SPECIFIC CONDUCTANCE	µmho/cm	500	2800	1600	970	980
ALKALINITY AS CaCO3	mg/l	120	440	100	110	120
NITRATES AS NO3-N	mg/l	0.78	0.26	0.16	0.20	0.44
PHENOLICS	mg/l	<0.006	0.008		0.006	<0.005
TOTAL LEAD	mg/l	0.014	0.400	0.037	0.040	0.086
DISSOLVED LEAD	mg/l	<0.003	0.013	<0.003	<0.003	<0.003
POLYCHLORINATED BIPHENYLS	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0
VOLATILE ORGANIC COMPOUNDS						
ACROLEIN	µg/l	<50	<50	<50	<50	<50
ACRYLONITRILE	µg/l	<50	<50	<50	<50	<50
BENZENE	µg/l	<5	<5	<5	<5	<5
BROMODICHLOROMETHANE	µg/l	<5	<5	<5	<5	<5
BROMOFORM	µg/l	<5	<5	<5	<5	<5
BROMOMETHANE	µg/l	<10	<10	<10	<10	<10
CARBON TETRACHLORIDE	µg/l	<5	<5	<5	<5	<5
CHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
CHLOROETHANE	µg/l	<10	<10	<10	<10	<10
2-CHLOROETHYLVINYL ETHER	µg/l	<10	<10	<10	<10	<10
CHLOROFORM	µg/l	<5	<5	<5	<5	<5
CHLOROMETHANE	µg/l	<10	<10	<10	<10	<10
DIBROMOCHLOROMETHANE	µg/l	<5	<5	<5	<5	<5
1,2-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,3-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,4-DICHLOROBENZENE	µg/l	<5	<5	<5	<5	<5
1,1-DICHLOROETHANE	µg/l	<5	4.5(J)	<5	<5	<5
1,2-DICHLOROETHANE	µg/l	9.1	<5	<5	<5	<5
1,1-DICHLOROETHENE	µg/l	74	7.6	<5	<5	<5
1,2-DICHLOROETHENE	µg/l	<5	<5	<5	<5	<5
1,2-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
cis-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
trans-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<5	<5
ETHYLBENZENE	µg/l	<5	<5	<5	<5	<5
METHYLENE CHLORIDE	µg/l	<10	<10	<10	<10	<10
1,1,2,2-TETRACHLOROETHANE	µg/l	<5	<5	<5	<5	<5
TETRACHLOROETHENE	µg/l	30	<5	<5	<5	<5
TOLUENE	µg/l	<5	<5	<5	<5	<5
1,1,1-TRICHLOROETHANE	µg/l	36	13	<5	<5	<5
1,1,2-TRICHLOROETHANE	µg/l	<5	<5	<5	<5	<5
TRICHLOROETHENE	µg/l	3(J)	<5	<5	<5	<5
TRICHLOROFLOUROMETHANE	µg/l	<5	<5	<5	<5	<5
VINYL CHLORIDE	µg/l	<10	<10	<10	<10	<10
TOTAL VOCs	µg/l	152.1	25.1	0	0	0

TABLE 5
(CONTINUED)

PARAMETER	UNITS	RAU-MW -007-16	RAU-MW -008-16	RAU-MW -009-16	RAU-MW -010-16	RAU-MW -011-16
WATER LEVEL	ft-msl	746.69	738.98	745.46	733.17	733.23
GENERAL CHEMISTRY						
pH	s.u.	6.1	6.8	6.0	5.9	6.8
SPECIFIC CONDUCTANCE	µmho/cm	920	960	520	25000	970
ALKALINITY AS CaCO3	mg/l	77	450	68	190	300
NITRATES AS NO3-N	mg/l	0.78	0.26	0.21	0.20	0.22
PHENOLICS	mg/l	0.007	0.006	<0.005	<0.006	<0.006
TOTAL LEAD	mg/l	0.010	0.033	0.013	0.054	0.009
DISSOLVED LEAD	mg/l	<0.003	<0.003	<0.003	<0.003	<0.003
POLYCHLORINATED BIPHENYLS	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0
VOLATILE ORGANIC COMPOUNDS						
ACROLEIN	µg/l	<50	<50	<50	<250	<50
ACRYLONITRILE	µg/l	<50	<50	<50	<250	<50
BENZENE	µg/l	<5	<5	<5	<25	<5
BROMODICHLOROMETHANE	µg/l	<5	<5	<5	<25	<5
BROMOFORM	µg/l	<5	<5	<5	<25	<5
BROMOMETHANE	µg/l	<10	<10	<10	<50	<10
CARBON TETRACHLORIDE	µg/l	<5	<5	<5	<25	<5
CHLOROBENZENE	µg/l	<5	<5	<5	<25	<5
CHLOROETHANE	µg/l	<10	<10	<10	<50	<10
2-CHLOROETHYLVINYL ETHER	µg/l	<10	<10	<10	<50	<10
CHLOROFORM	µg/l	<5	<5	<5	<25	<5
CHLOROMETHANE	µg/l	<10	<10	<10	<50	<10
DIBROMOCHLOROMETHANE	µg/l	<5	<5	<5	<25	<5
1,2-DICHLOROBENZENE	µg/l	<5	<5	<5	<25	<5
1,3-DICHLOROBENZENE	µg/l	<5	<5	<5	<25	<5
1,4-DICHLOROBENZENE	µg/l	<5	<5	<5	<25	<5
1,1-DICHLOROETHANE	µg/l	<5	<5	<5	640	13
1,2-DICHLOROETHANE	µg/l	<5	<5	<5	<25	<5
1,1-DICHLOROETHENE	µg/l	<5	<5	<5	64	<5
1,2-DICHLOROETHENE	µg/l	<5	<5	<5	<25	<5
1,2-DICHLOROPROPANE	µg/l	<5	<5	<5	<25	<5
cis-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<25	<5
trans-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<25	<5
ETHYLBENZENE	µg/l	<5	<5	<5	<25	<5
METHYLENE CHLORIDE	µg/l	<10	<10	<10	<50	<10
1,1,2,2-TETRACHLOROETHANE	µg/l	<5	<5	<5	<25	<5
TETRACHLOROETHENE	µg/l	<5	<5	<5	<25	<5
TOLUENE	µg/l	<5	<5	<5	<25	<5
1,1,1-TRICHLOROETHANE	µg/l	<5	<5	<5	230	<5
1,1,2-TRICHLOROETHANE	µg/l	<5	<5	<5	<25	<5
TRICHLOROETHENE	µg/l	<5	<5	12	<25	<5
TRICHLOROFLOUROMETHANE	µg/l	<5	<5	<5	<25	<5
VINYL CHLORIDE	µg/l	<10	<10	<10	35 (J)	<10
TOTAL VOCs	µg/l	0	0	12	969	13

TABLE 5
(CONTINUED)

PARAMETER	UNITS	RAU-MW -012-16	RAU-MW -012R-16	RAU-MW -000-16	TRIP BLANK
WATER LEVEL	ft-msl	734.39	REPLICATE	BLANK	
GENERAL CHEMISTRY					
pH	s.u.	6.6		7.0	
SPECIFIC CONDUCTANCE	µmho/cm	1600		57	
ALKALINITY AS CaCO3	mg/l	740		15	
NITRATES AS NO3-N	mg/l	0.10		<0.10	
PHENOLICS	mg/l	<0.005		0.010	
TOTAL LEAD	mg/l	0.038		0.012	
DISSOLVED LEAD	mg/l	<0.003		<0.003	
POLYCHLORINATED BIPHENYLS	µg/l	<1.0		<1.0	
VOLATILE ORGANIC COMPOUNDS					
ACROLEIN	µg/l	<50	<50	<50	<50
ACRYLONITRILE	µg/l	<50	<50	<50	<50
BENZENE	µg/l	<5	<5	<5	<5
BROMODICHLOROMETHANE	µg/l	<5	<5	<5	<5
BROMOFORM	µg/l	<5	<5	<5	<5
BROMOMETHANE	µg/l	<10	<10	<10	<10
CARBON TETRACHLORIDE	µg/l	<5	<5	<5	<5
CHLOROBENZENE	µg/l	<5	<5	<5	<5
CHLOROETHANE	µg/l	<10	<10	<10	<10
2-CHLOROETHYLVINYL ETHER	µg/l	<10	<10	<10	<10
CHLOROFORM	µg/l	<5	<5	<5	<5
CHLOROMETHANE	µg/l	<10	<10	<10	<10
DIBROMOCHLOROMETHANE	µg/l	<5	<5	<5	<5
1,2-DICHLOROBENZENE	µg/l	<5	<5	<5	<5
1,3-DICHLOROBENZENE	µg/l	<5	<5	<5	<5
1,4-DICHLOROBENZENE	µg/l	<5	<5	<5	<5
1,1-DICHLOROETHANE	µg/l	37	33	<5	<5
1,2-DICHLOROETHANE	µg/l	<5	<5	<5	<5
1,1-DICHLOROETHENE	µg/l	<5	<5	<5	<5
1,2-DICHLOROETHENE	µg/l	<5	<5	<5	<5
1,2-DICHLOROPROPANE	µg/l	<5	<5	<5	<5
cis-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<5
trans-1,3-DICHLOROPROPANE	µg/l	<5	<5	<5	<5
ETHYLBENZENE	µg/l	<5	<5	<5	<5
METHYLENE CHLORIDE	µg/l	<10	<10	<10	<10
1,1,2,2-TETRACHLOROETHANE	µg/l	<5	<5	<5	<5
TETRACHLOROETHENE	µg/l	<5	<5	<5	<5
TOLUENE	µg/l	<5	<5	<5	4 (J)
1,1,1-TRICHLOROETHANE	µg/l	<5	<5	<5	<5
1,1,2-TRICHLOROETHANE	µg/l	<5	<5	<5	<5
TRICHLOROETHENE	µg/l	<5	<5	<5	<5
TRICHLOROFLOUROMETHANE	µg/l	<5	<5	<5	<5
VINYL CHLORIDE	µg/l	<10	<10	<10	<10
TOTAL VOCs	µg/l	37	33	0	4

APPENDIX II
Risk Calculations
North End Site

Intake Calculations

Ingestion of Drinking Water:

Intake= ((IR)(EF)(ED))/((BW)(AT))

Variable Values	Adult	Child	
Ingestion Rate (IR)	2 L/day	1 L/day	
Exposure Frequency (EF)	365 days/year	365 days/year	
Exposure Duration (ED)	30 years	6 years	
Body Weight (BW)	70 kg	15 kg	
Averaging Time (AT)	10950 days	2190 days	(Noncarcinogenic Effects)
	25550 days	25550 days	(Carcinogenic Effects)

Inhalation of Volatized Chemicals:

Intake= ((IR)(ET)(EF)(ED))/((BW)(AT))

Variable Values	Adult	Child
Ingestion Rate (IR)	0.83 m3/hr	0.83 m3/hr
Exposure Time (ET)	0.25 hr/ day	0.25 hr/ day
Exposure Frequency (EF)	365 days/year	365 days/year
Exposure Duration (ED)	30 years	6 years
Body Weight (BW)	70 kg	15 kg
Averaging Time (AT)	10950 days	2190 days
	25550 days	25550 days

Final Intake = (Intake)(Chemical Concentration)

Hazard Index = (Final Intake)/(Reference Dose)

Cancer Risk = (Final Intake)(Slope Factor)

FINAL INTAKE CALCULATIONS -Adult, Noncancer

Pathway: Ingestion of contaminated drinking water

Chemical	Concentration	Intake	Final Intake	RfD	Hazard Index
Chloroethane	0.00039	0.028571429	1.11429E-05		ND
Chloromethane	0.0000972	0.028571429	2.77714E-06		ND
1,2 Dichlorobenzene	0.0000521	0.028571429	1.48857E-06	0.09	1.65397E-05
1,1 Dichloroethane	0.00149	0.028571429	4.25714E-05	0.1	0.000425714
1,2 Dichloroethane	0.0000481	0.028571429	1.37429E-06		ND
1,1 Dichloroethene	0.00084	0.028571429	0.000024	0.009	0.002666667
1,2 Dichloroethene	0.000058	0.028571429	1.65714E-06	0.01	0.000165714
Tetrachloroethene	0.0000855	0.028571429	2.44286E-06	0.01	0.000244286
1,1,1 Trichloroethane	0.000578	0.028571429	1.65143E-05	0.09	0.000183492
Trichloroethene	0.0000569	0.028571429	1.62571E-06	0.006	0.000271
Vinyl Chloride	0.000116	0.028571429	3.31429E-06		ND
			Pathway Hazard Index		**0.003973412**

Pathway: Inhalation of contaminated air

Chemical	Concentration	Intake	Final Intake	RfC	Hazard Index
Chloroethane	0.00039	0.002964286	1.15607E-06	10	1.16E-07
Chloromethane	0.0000972	0.002964286	2.88129E-07		ND
1,2 Dichlorobenzene	0.0000521	0.002964286	1.54439E-07	0.04	3.86E-06
1,1 Dichloroethane	0.00149	0.002964286	4.41679E-06	0.1	4.41679E-05
1,2 Dichloroethane	0.0000481	0.002964286	1.42582E-07		ND
1,1 Dichloroethene	0.00084	0.002964286	0.00000249		ND
1,2 Dichloroethene	0.000058	0.002964286	1.71929E-07		ND
Tetrachloroethene	0.0000855	0.002964286	2.53446E-07		ND
1,1,1 Trichloroethane	0.000578	0.002964286	1.71336E-06	0.3	5.70E-06
Trichloroethene	0.0000569	0.002964286	1.68668E-07		ND
Vinyl Chloride	0.000116	0.002964286	3.43857E-07		ND
			Pathway Hazard Index		**0.000053843**

FINAL INTAKE CALCULATIONS -Child, Noncancer

Pathway: Ingestion of contaminated drinking water

Chemical	Concentration	Intake	Final Intake	RfD	Hazard Index
Chloroethane	0.00039	0.061603376	2.40253E-05		ND
Chloromethane	0.0000972	0.061603376	5.98785E-06		ND
1,2 Dichlorobenzene	0.0000521	0.061603376	3.20954E-06	0.9	3.56615E-06
1,1 Dichloroethane	0.00149	0.061603376	9.1789E-05	1	9.1789E-05
1,2 Dichloroethane	0.0000481	0.061603376	2.96312E-06		ND
1,1 Dichloroethene	0.00084	0.002025316	1.70127E-06	0.009	0.00018903
1,2 Dichloroethene	0.000058	0.002025316	1.17468E-07	0.1	1.17468E-06
Tetrachloroethene	0.0000855	0.002025316	1.73165E-07	0.1	1.73165E-06
1,1,1 Trichloroethane	0.000578	0.002025316	1.17063E-06	0.09	1.30E-06
Trichloroethene	0.0000569	0.002025316	1.15241E-07	0.006	0.0000192
Vinyl Chloride	0.000116	0.002025316	2.34937E-07		ND
			Pathway Hazard Index		**0.000307991**

Pathway: Inhalation of contaminated air

Chemical	Concentration	Intake	Final Intake	RfC	Hazard Index
Chloroethane	0.00039	0.0127827	4.98525E-06	10	4.99E-07
Chloromethane	0.0000972	0.0127827	1.24248E-06		ND
1,2 Dichlorobenzene	0.0000521	0.0127827	6.65979E-07	0.4	1.66E-06
1,1 Dichloroethane	0.00149	0.0127827	1.90462E-05	1	1.90E-05
1,2 Dichloroethane	0.0000481	0.0127827	6.14848E-07		ND
1,1 Dichloroethene	0.00084	0.0127827	1.07375E-05		ND
1,2 Dichloroethene	0.000058	0.0127827	7.41397E-07		ND
Tetrachloroethene	0.0000855	0.0127827	1.09292E-06		ND
1,1,1 Trichloroethane	0.000578	0.0127827	7.3884E-06	3	2.46E-06
Trichloroethene	0.0000569	0.0127827	7.27336E-07		ND
Vinyl Chloride	0.000116	0.0127827	1.48279E-06		ND
			Pathway Hazard Index		**0.000023619**

FINAL INTAKE CALCULATIONS - Adult, Cancer

Pathway: Ingestion of contaminated drinking water

Chemical	Concentration	Intake	Final Intake	Slope Factor	Cancer Risk
Chloroethane	0.00039	0.012244898	4.77551E-06		ND
Chloromethane	0.0000972	0.012244898	1.1902E-06	0.013	1.54727E-08
1,2 Dichlorobenzene	0.0000521	0.012244898	6.37959E-07		ND
1,1 Dichloroethane	0.00149	0.012244898	1.82449E-05		ND
1,2 Dichloroethane	0.0000481	0.012244898	5.8898E-07	0.091	5.35971E-08
1,1 Dichloroethene	0.00084	0.012244898	1.02857E-05	0.6	6.17143E-06
1,2 Dichloroethene	0.000058	0.012244898	7.10204E-07		ND
Tetrachloroethene	0.0000855	0.012244898	1.04694E-06		ND
1,1,1 Trichloroethane	0.000578	0.012244898	7.07755E-06		ND
Trichloroethene	0.0000569	0.012244898	6.96735E-07	0.011	7.66408E-09
Vinyl Chloride	0.000116	0.012244898	1.42041E-06	1.9	2.69878E-06
			Pathway Cancer Risk		**8.95E-06**

Pathway: Inhalation of contaminated air

Chemical	Concentration	Intake	Final Intake	Slope Factor	Cancer Risk
Chloroethane	0.00039	0.030612245	1.19388E-05		ND
Chloromethane	0.0000972	0.030612245	2.97551E-06	0.006	3.86816E-08
1,2 Dichlorobenzene	0.0000521	0.030612245	1.5949E-06		ND
1,1 Dichloroethane	0.00149	0.030612245	4.56122E-05		ND
1,2 Dichloroethane	0.0000481	0.030612245	1.47245E-06	0.091	1.33993E-07
1,1 Dichloroethene	0.00084	0.030612245	2.57143E-05	1.2	0.000030857
1,2 Dichloroethene	0.000058	0.030612245	1.77551E-06		ND
Tetrachloroethene	0.0000855	0.030612245	2.61735E-06		ND
1,1,1 Trichloroethane	0.000578	0.030612245	1.76939E-05		ND
Trichloroethene	0.0000569	0.030612245	1.74184E-06	0.017	2.90E-08
Vinyl Chloride	0.000116	0.030612245	3.55102E-06	0.29	0.000001029
			Pathway Cancer Risk		**0.000032087**

FINAL INTAKE CALCULATIONS - Child, Cancer

Pathway: Ingestion of contaminated drinking water

Chemical	Concentration	Intake	Final Intake	Slope Factor	Cancer Risk
Chloroethane	0.00039	0.005714286	2.22857E-06		ND
Chloromethane	0.0000972	0.005714286	5.55429E-07	0.013	7.22057E-09
1,2 Dichlorobenzene	0.0000521	0.005714286	2.97714E-07		ND
1,1 Dichloroethane	0.00149	0.005714286	8.51429E-06		ND
1,2 Dichloroethane	0.0000481	0.005714286	2.74857E-07	0.091	2.5012E-08
1,1 Dichloroethene	0.00084	0.005714286	0.0000048	0.6	0.00000288
1,2 Dichloroethene	0.000058	0.005714286	3.31429E-07		ND
Tetrachloroethene	0.0000855	0.005714286	4.88571E-07		ND
1,1,1 Trichloroethane	0.000578	0.005714286	3.30286E-06		ND
Trichloroethene	0.0000569	0.005714286	3.25143E-07	0.011	3.57657E-09
Vinyl Chloride	0.000116	0.005714286	6.62857E-07	1.9	1.25943E-06
			Pathway Cancer Risk		**4.18E-06**

Pathway: Inhalation of contaminated air

Chemical	Concentration	Intake	Final Intake	Slope Factor	Cancer Risk
Chloroethane	0.00039	0.001185714	4.62429E-07		ND
Chloromethane	0.0000972	0.001185714	1.15251E-07	0.006	6.92E-10
1,2 Dichlorobenzene	0.0000521	0.001185714	6.17757E-08		ND
1,1 Dichloroethane	0.00149	0.001185714	1.76671E-06		ND
1,2 Dichloroethane	0.0000481	0.001185714	5.70329E-08	0.091	5.18999E-09
1,1 Dichloroethene	0.00084	0.001185714	0.000000996	1.2	1.20E-06
1,2 Dichloroethene	0.000058	0.001185714	6.87714E-08		ND
Tetrachloroethene	0.0000855	0.001185714	1.01379E-07		ND
1,1,1 Trichloroethane	0.000578	0.001185714	6.85343E-07		ND
Trichloroethene	0.0000569	0.001185714	6.74671E-08	0.017	1.00E-09
Vinyl Chloride	0.000116	0.001185714	1.37543E-07	0.29	3.90E-08
			Pathway Cancer Risk		**1.24E-06**